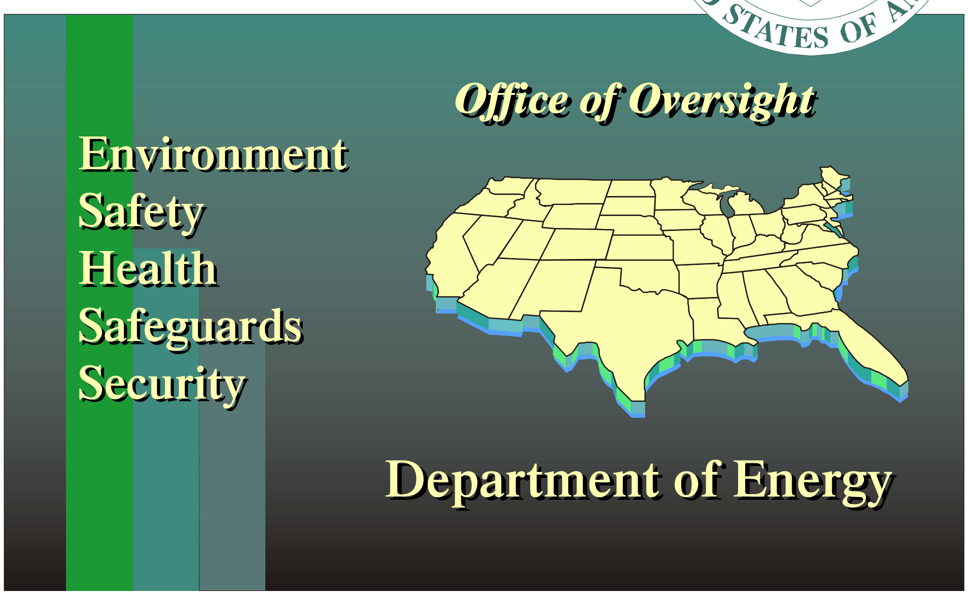
EH2PUB/12-98/02SH

OVERSIGHT

Office of Oversight
Independent Technical Review of

Argonne National Laboratory-West Radiation Contamination Incident

December 1998



Office of Environment, Safety, and Health

Executive Summary

On August 19, 1998, during the repair of a manipulator at the Fuel Conditioning Facility (FCF) at Argonne National Laboratory-West (ANL-W), 11 workers were contaminated with radioactive material on their skin or clothing. Four of these workers also received internal contamination. Once the contamination was discovered, personnel evacuated the facility, activated the site emergency response organization, and initiated recovery actions. This report documents an independent review conducted by the Office of Environment, Safety and Health, Office of Oversight September 14-18, 1998, to evaluate the event, the subsequent emergency response, and the event investigation jointly conducted by Argonne National Laboratory (ANL) and the Department of Energy Chicago Operations Office (CH).

The FCF contains two hot cells that allow workers to safely handle radioactive material using externally controlled manipulators from behind five-foot-thick shielding walls. During repair of one manipulator, radioactive material was released, causing contamination of personnel and the facility. Due to the extent of the contamination and the concern that personnel who evacuated the facility may have taken contamination off site, the emergency response organization was activated. This resulted in the activation of the Idaho National Engineering and Environmental Laboratory's (INEEL) Emergency Operations Center (EOC). Re-entry plans were developed and executed to stop the source of the contamination.

In accordance with internal procedures, ANL directed an investigation of the event. The investigation team included personnel from the CH Argonne Group, ANL, and ANL-W. The report addressed the five core functions of integrated safety management and identified six judgments of need requiring corrective actions. The ANL team concluded that the root cause for the event was the failure of the engineering and maintenance work control system to ensure that systems intended to control radioactive contamination during maintenance and repair are engineered, evaluated, and implemented with a degree of rigor commensurate with the potential hazards.

To address the judgments of need, ANL developed a plan identifying 24 corrective actions, including specific actions to provide additional training, revise the pre-job briefing requirements, reclassify and revise procedures, and perform engineering reviews of modifications. The corrective action plan does not address emergency preparedness issues and only commits to conducting an evaluation of personnel protection requirements. The corrective action plan does not evaluate programmatic issues related to this event, such as engineering design changes, unreviewed safety question determinations, emergency preparedness, and radiological control.

The ANL review did not address the emergency preparedness issues that were evident in the response to the event. Although the evacuation and response by facility personnel were appropriate and conservative, the activation of the Emergency Command Center and subsequent activation of the INEEL EOC indicated weaknesses in the ANL-W emergency management program. These weaknesses included communications, inadequate training, and a failure to follow site procedures.

The failure to follow site procedures resulted in a delay of nearly 30 minutes in the notification of offsite organizations and personnel. Emergency control center procedures and the ANL-W Emergency Plan were not implemented appropriately in that personnel did not man the INEEL EOC. A sitewide drill involving the INEEL EOC had not been conducted during the past two years.

The Office of Oversight identified opportunities for improvement in emergency preparedness, radiological controls, and integrated safety management, in addition to the judgments of need from the ANL-W review. Further program reviews as identified in this report and implementation of corrective actions pertaining to the ANL corrective actions will help minimize similar events. ANL-W has begun to implement integrated safety management. Further efforts to fully implement integrated safety management in plant activities, particularly with respect to work planning and control, will help improve facility safety.

1.0 Introduction

On August 19, 1998, during the repair of a manipulator seal tube in the Fuel Conditioning Facility (FCF) at Argonne National Laboratory-West (ANL-W), contamination was released into the operating aisle. Maintenance work was in progress on the manipulator seal tube when a health physics technician discovered contamination on the back of his shirt. Ten other workers were identified with some level of contamination. In addition, four of the 11 workers were found to also have received internal contamination as a result of the release; however, none of these individuals were contaminated in excess of regulatory or administrative exposure limits. The facility was evacuated, and an alert emergency was declared. The emergency response to this alert included activation of the ANL-W Emergency Command Center (ECC) and the Idaho National Engineering and Environmental Laboratory (INEEL) Emergency Operations Center (EOC). An alert emergency was declared because of a concern that facility personnel may have left the site without being surveyed for contamination. Subsequent investigations have determined the source of the release was a “bagging ring” that had been installed to contain radioactive contamination during maintenance on the manipulator’s seal tube.

The Office of Oversight conducted an independent review of this event because of the number of personnel contaminated and the activation of the emergency response organization. The purpose of this review was to evaluate the effectiveness of the local investigation of the event, the circumstances of the event itself, and subsequent emergency response to ensure that appropriate corrective actions are being taken to minimize the potential for similar events. The Oversight review team consisted of four individuals with extensive experience in integrated safety management, event investigation, root cause analysis, conduct of operations, maintenance, radiation protection, emergency management, and safety analysis. The Office of Oversight conducted interviews with appropriate workers and managers and performed document reviews and walkdowns of the FCF equipment and procedures.

Argonne National Laboratory-West: *The site is located west of Idaho Falls and occupies 810 acres. The silver dome is Experimental Breeder Reactor-II (EBR-II) containment. The Fuel Conditioning Facility is adjacent to EBR-II.*

ANL-W was established in 1958, on a site 26 miles west of Idaho Falls, Idaho. The 810-acre site, located adjacent to the INEEL, includes 84 acres inside the property protection area. The cognizant secretarial officer for the site is the Director, Office of Nuclear Energy, Science and Technology (NE), primarily the Office of Facilities (NE-40). The responsible operations and area offices are the U.S. Department of Energy (DOE) Chicago Operations Office (CH) and Argonne Group-West. The University of Chicago serves as the contractor for operating the site. The site employs six Federal and approximately 750 contractor personnel. The site develops environmental remediation technologies as its primary mission. Activities include placing the Experimental Breeder Reactor-II (EBR-II) in a radiologically and industrially safe shutdown condition, developing techniques for treating EBR-II fuel for long-term storage, preparing sodium waste for disposal, and characterizing solid waste for eventual shipment to the Waste Isolation Pilot Plant.

The FCF has been in operation for 30 years and was recently refurbished to support the current mission. FCF contains two hot cells, one with an air atmosphere and the other with an argon gas atmosphere. These hot cells allow workers to safely handle radioactive material using externally controlled manipulators from behind five-foot-thick shield walls. Presently, the principal operation in the hot cells involves demonstrating an electro-metallurgical method for treating spent nuclear fuel. This method uses a multistep process to dismantle nuclear fuel assemblies and chop the resulting fuel elements into small pieces that can be dissolved in an electro-refiner. The resulting nuclear material is then deposited on a cathode, which is heated. On heating, the non-nuclear material boils away and is recycled; then the cathode melts the nuclear material, which is cooled into metal ingots. This process is being demonstrated on spent nuclear fuel from EBR-II.

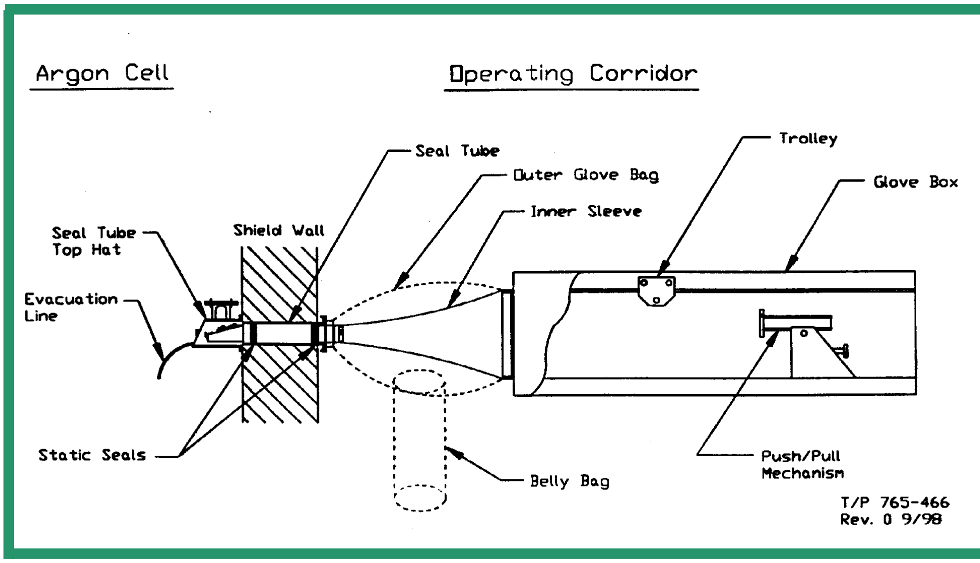
The Fuel Conditioning Facility: *Its current mission is to support development and demonstration of the electro-metallurgical technology for the treatment of spent nuclear fuel.*

2.0 Event Sequence

The repair of the electrical seal package on the in-cell side of the manipulator consisted of removing the in-cell arm and out-of-cell arm on the manipulator to allow withdrawal of the seal tube from the penetration. A “top hat” assembly was installed on the in-cell side to minimize the loss of argon from the cell.

The penetration is approximately ten feet from the floor. A glovebox that can be raised or lowered on a lift is used to gain access to the seal tube penetration. The glovebox is rolled into position and aligned with the penetration. Workers stand on the platform around the glovebox to conduct the work. Once the manipulator arms are removed, a bagging ring is installed. Double plastic sleeves are then taped to the bagging ring and the glovebox to provide containment.

The seal tube is extracted from the penetration into the glovebox using the push-pull mechanism. During this process, an argon purge is established to minimize the potential for introducing air into the argon cell. Different pressures are established for the top-hat assembly, the containment, and the glovebox. At the time the contamination was discovered, the seal tube was being reinserted into the cell penetration.



Schematic of the Seal Tube and Glovebox: *The plastic outer glove bag and inner sleeve serve as the containment between the glovebox and shield wall. The seal tube is extracted from the shield wall through the inner sleeve and into the glovebox for maintenance.*

Time Event Line

Time	Event
May 1996	Procedures for installation of J seal tube modified and reviewed.
Early 1997	Modification to bagging ring identified and implemented.
8/17/98	Work request prepared for replacing the electrical seal package on Window 3, right hand manipulator slave arm. Pre-job briefing for mechanics conducted.
8/18/98 0700	Began raising argon cell pressure for seal tube replacement. Mechanics install bagging ring, glovebox, and inner and outer bags.
8/18/98 1100-1130	Mechanics complete installation of glovebox and bags. Begin one-hour purge of glovebox. Mechanics break for lunch while job supervisor remains at the work site. Job supervisor pressurizes outer bag to look for leaks, and is satisfied that no leaks are evident.
1230-1430	Mechanics return from lunch, remove seal tube, and complete repairs to the electrical seal package.
1430-1530	Mechanics reinsert the seal tube. During reinsertion, pressure in the outer bag is allowed to increase to 0.8" water. When seal tube is nearly fully inserted, a health physics technician takes three terrycloth wipes. No contamination detected.
1530-1545	A second health physics technician who had been watching the job leaves the area to go to the bathroom. He finds contamination on his shirt (lower middle back) at a personnel contamination monitor (PCM 1B). Returns to seal replacement job to inform them he is contaminated. At about the same time, a worker comes out of the basement with contamination on his shoe.
1550	Facility area supervisor and operations manager notified of personnel contaminations.
1608	Facility evacuated.
1610	Facility area supervisor and on-scene commander establish incident command.
1615	Emergency action manager activates Emergency Command Center.
1620	Emergency Command Center declared operational. FCF personnel accountability verified.
1625	Buses authorized to leave on schedule.
1626	Emergency Command Center receives a report that a number of people in the evacuation rally point conference room need to be surveyed.
1628	Emergency action manager holds departure of buses.
1630	All FCF personnel recalled from the buses for contamination survey.
1635	Emergency action manager declares alert emergency for contamination in the FCF. Emergency action manager assumes incident commander responsibilities. On-scene command split; OSC-1 in parking lot, OSC-2 at FCF.
1637	Announcement made to employees, “Contamination event in progress in Building 765.”
1650	Surveys completed for FCF personnel on buses and at the rally point in the conference room. No contamination detected. A re-entry team, consisting of a health physics technician and a manipulator repair group chief technician, enters the FCF in full anti-contamination gear and respirators to inspect the seal tube repair work site. No holes or tears are found.
1745	The ANL emergency action manager briefs the INEEL Emergency Operations Center in Idaho Falls on the status of the alert. The Emergency Command Center establishes continuous phone communications with notification center and the INEEL Emergency Operations Center.
1756	INEEL Emergency Operations Center declared operational.
1809	Contamination is identified on the shoe of a worker sent to Central Facilities for a whole body count, indicating that health physics surveys at EBR-II may not have been effective. Potential for spread of contamination offsite on the buses leads to decision to survey all buses that evening.
2104	Re-entry team applies sealant to bagging ring seal.
2105	Alert terminated.
2400	Surveys of buses completed. No contamination detected.

Personnel Contamination Monitor: *This monitor is used by workers to monitor themselves for external contamination prior to leaving the FCF.*

The direct cause of this event was improper installation of the bagging ring. Contamination surveys performed after the event indicated significant contamination between the surfaces of the flange face and the bagging ring. Operation of the glovebox at a positive pressure with respect to the operating aisle subsequently caused the release of radioactive material. Activity levels within the seal tube are high, and the small release contaminated 11 facility workers.

The root cause of this event was a failure to analyze the hazards and implement controls for those hazards. The modifications to the bagging ring were not appropriately classified with respect to safety significance. Consequently, an unreviewed safety question determination was not performed. The engineering redesign of the bagging ring in early 1997 did not include analysis of the radiological hazards associated with installing the bagging ring. Procedures did not provide appropriate instruction for installing or monitoring the bagging ring during the maintenance activity. Conservative radiological practices were not implemented to prevent the spread of contamination.

3.1 Integrated Safety Management (Five Core Functions)

DOE Policy 450.4, Safety Management System Policy, defines five core safety management functions that provide the necessary structure for any work activity that could affect the safety and health of the public, the workers, or the environment. The functions are applied to systematically integrate safety into the management of work practices at the institutional, facility, project and activity level for all work. The following sections provide an evaluation of the event with respect to the five core functions of safety management at the FCF.

3.1.1 Define Work

At the institutional level, work required to satisfy mission objectives must be broken down so that it can be planned and performed by facility personnel. Work must also be defined to a level of detail that permits expectations to be clearly communicated. Clear definition of work also allows effective identification and prioritization of tasks and allocation of resources.

Three procedures defined the scope of work to be performed for the seal tube repair. The first procedure is for installing a "top hat" device inside the argon cell to keep air out of the cell during maintenance on the manipulator. According to this procedure, the top hat forms a secondary barrier to minimize the introduction of air into the argon cell during the installation and removal of the seal tubes. The top hat isolates the penetration's opening containing the seal tube to allow better pressure control inside the containment structure. Mechanics are required to ensure a proper seal by evacuating the top hat. However, the installation procedure does not treat the top hat as part of the secondary confinement barrier, although operations in the cell must be secured before conducting maintenance on the manipulator.

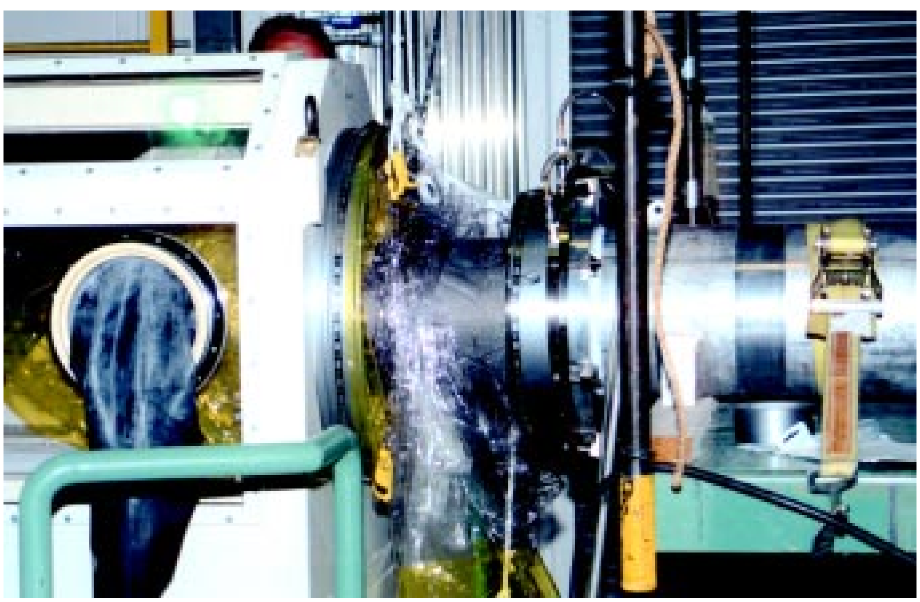
The second procedure defines the requirements and process for actually removing and reinstalling the seal tube, including installation of the glovebox and associated seals. This procedure applies to both the Hot Fuel Examination Facility (HFEF) and the FCF. The contamination levels in the FCF are much higher than in the HFEF, however, the procedures make no distinction between the two facilities. According to this procedure, the job coordinator specifies the procedure segments that are to be performed.

The third procedure provides instructions for operating the gloveboxes, including removal, installation, and maintenance of penetrations into the argon- or air-cell walls in FCF and HFEF. This procedure covers operation of the argon supply, vacuum pumps, and the equipment transport vehicle. The procedure contains alarm settings, describes glovebox design features, and provides the normal operating limits for the glovebox.

Collectively, these procedures define the work to be accomplished. However, the procedures for the seal tube repair and the glovebox operation need improvement to specifically address the facility in which the work is to occur. ANL-W has committed to revising these procedures to improve their usability.

3.1.2 Analyze Hazards

After the work is defined but before it is performed, hazards must be identified, analyzed, and categorized so that appropriate administrative and engineering controls to prevent or mitigate hazards can be developed. Hazards may change over the life of a facility or from job to job and must, therefore, be reanalyzed in the context of the current work activity. As part of an effective integrated safety management framework, it is essential that institutional processes be in place to ensure that hazards are adequately analyzed and used to establish controls before commencing work.



Mockup of Containment: *This is a mockup showing the connection of the bagging ring and glovebox together to conduct work on the seal tube.*

The hazard analysis for the maintenance activity was not clearly documented during preparation for the work on the seal tube. This is evident in the lack of appropriate personnel dosimetry and lack of contamination monitoring around the seal flange. Pre-job radiation surveys were not conducted in preparation for the work. Instead, historical contamination levels were used to complete the radiation work permit (RWP), and this did not translate into appropriate personnel dosimetry until after the job began and the actual radiation levels were obtained. While the three procedures used to conduct the work provided several precautions about monitoring for contamination, they did not specifically identify the bagging ring as a potential source. The focus of the precautions relates directly to tears and rips that could develop in the plastic used between the bagging ring and the glovebox.

Health physics personnel believed that the historical contamination and radiation levels shown on the RWP were above the actual levels. The work preparations did not adequately identify appropriate, conservative precautions for conducting work on highly contaminated equipment or identify potential sources for proper monitoring to prevent a release. This was evident in that a small leak in the bagging ring connection to the seal tube penetration flange during this event caused widespread contamination, in the absence of appropriate personnel dosimetry.

Bagging Ring: *The bagging ring attaches to the cell wall to permit installation of the plastic containment. Shown is the seating surface with O-rings and J-bolts.*

An unreviewed safety question determination was not performed before the design changes to the bagging ring assembly were implemented in early 1997. Unreviewed safety question determinations are required for facility modifications that could impact the safety basis of the facility. Furthermore, the modification to the bagging ring was accomplished without using the approved engineering procedures that control the design changes for nuclear-related equipment. Consequently, the modifications did not receive any additional independent design reviews. The responsible engineer independently determined that the bagging ring was a quality Level-C component, and was thus exempt from the engineering design procedure. This engineering design procedure provides for exceptions for modifications that are "simple and inexpensive QA Level-C tasks." However, the procedure does not provide thresholds or guidance for determining which tasks are "simple and inexpensive." The redesign of this bagging ring, due to the machining and materials involved and consequences of failure, should have been subject to the requirements identified in the engineering design procedure that would have resulted in more extensive reviews and approvals.

The glovebox operating procedure provides limits on differential pressure between the glovebox, the plastic containment sleeves, and the argon cell. The hazard analyses, however, did not evaluate the high levels of contamination expected inside the glovebox. Operating the glovebox at a positive pressure with respect to the operating aisle is not in accordance with standard contamination control practices.

3.1.3 Develop and Implement Hazard Controls

Hazard controls include engineered controls (buildings, enclosures, safety systems, ventilation systems, controls and instrumentation, etc.) and administrative measures (limits, personal protective equipment, safety requirements imbedded in procedures, warning signs, environmental monitoring, or additional training). The established level of control must be consistent with the need to protect workers, the public, and the environment from all hazards associated with work activities.

A strong linkage is needed between facility, project, and activity-level hazard analyses and the established controls as part of a defined, integrated safety management work planning process. An important part of the process is to integrate hazard controls directly into the procedures, work packages, and sequential work steps necessary to perform work.

Controls for this work activity can be categorized as engineered, procedural, and radiological. Engineered controls included the glovebox and bagging ring arrangement. Radiological controls were implemented through the RWP, which specified protective clothing requirements, and through the procedures that identified survey requirements. Procedures governed how the controls were to be implemented and dictated the work sequence.

Controls on the assembly of the bagging ring are not clearly established in the procedure. One step in the procedure states, “Install the bagging ring on the penetration flange.” The procedure does not provide guidance on alignment of the flange, installation of the O-ring, or torque requirements for the J-bolts. Moreover, the procedure does not require a leak check following installation. The design change to the bagging ring was not reviewed in accordance with engineering design procedures, which could have helped ensure that appropriate steps for fastening the bagging ring to the flange were specified clearly and understood by the workers.

Two procedures used during the maintenance activity are annotated as “General Information Use.” These procedures are also designated as being technical safety requirement/operational safety requirement-related procedures. Site administrative procedures allow General Information Use procedures to be conducted from memory. For this maintenance activity, the classification is inconsistent with conduct of operations principles. These procedures contained steps that required verification of facility conditions before the maintenance activity started. Procedures that affect safety-related equipment require step-by-step use, and the facility safety review committee should have reviewed them to ensure that facility safety would be maintained.

Glovebox Assembly: *Workers in lab coats conduct a walkthrough of the seal tube repair on a mockup. Note the extension of the glovebox gloves, indicating a positive pressure with respect to the area that the workers occupy.*

An RWP was developed and approved for the work evolution. This permit defined the radiological conditions expected during the maintenance on the seal tube and defined the personal protective equipment necessary to conduct the work. The RWP required personnel assigned to this task to wear a lab coat, one pair of rubber gloves taped at the wrist, and a thermoluminescent dosimeter and self-reading dosimeter for radiation monitoring. These requirements were based on knowledge from previous maintenance activities.

Radiological surveys conducted during the maintenance activity did not test all potential sources of contamination. During the seal tube removal, health physics technicians executed hold points by conducting surveys (smears) to detect potential contamination, focusing on the plastic containment sleeve to detect rips and tears. The smears indicated no contamination just before the discovery of contamination on one facility worker. None of the procedures indicated that the bagging ring seal was a potential source of contamination.

Upon removal of the seal tube, surveys of the tip showed high radiation levels, indicating the presence of extremely high levels of contamination. The health physics technician stopped work, notified his supervisor, and required extremity monitoring for workers handling the sleeve. The seal tube was decontaminated, and the dose rates were reduced. The estimated dose rates on the RWP were similar to those experienced during the activity. However, the RWP did not require the use of extremity dosimetry, which is a standard practice when dealing with the levels of contamination and radiation dose rates present on the seal tube.

The degree of control for personnel entry into the seal tube repair area was not conservative with respect to the potential radiological hazards within the work area and not consistent with radiological control requirements. In-cell radiological surveys indicated contamination levels in excess of the instrument's capability. Historically, the seal tubes in the facility have been highly contaminated, and the integrity of the plastic sleeve is relied on to control potential contamination. The work area was controlled as a radiological buffer area by hanging a yellow/magenta rope across the passage; however, no signs or placards were hung to notify personnel of this designation. Signs were not posted to delineate the boundary for the radiation area. Instead of posting or other controls, the laboratory radiological control manual permits a knowledgeable person to act as a boundary for periods less than eight continuous hours. During this maintenance activity, the health physics technician who fulfilled that role was conducting other work activities and could not maintain the positive controls required by the laboratory manual.

Monitoring of airborne radioactivity concentrations was not sufficient to protect the workers from internal uptakes of radioactive material. Job-specific air sampling was not required by the work procedures or the RWP. A permanently installed continuous air monitor located approximately eight feet from the actual work location was not adequately positioned to monitor the exposed workers. Although an increase in radioactivity was observed on this monitor, the level was insufficient to cause an alarm. Continuous air monitoring equipment is needed in areas where potentially exposed workers may need to take immediate action to minimize or terminate inhalation exposures.

3.1.4 Perform Work within Controls

Performing work within the established controls is essential in assuring worker safety. Ideally, at this point, the particular work activity has been analyzed, controls have been established, workers understand the hazards and are capable of performing the work within the controls, and workers are trained and ready to begin work safely.

In the event at the FCF, the work was performed in accordance with the established procedures except for pressure control within the temporary containment. The outer containment was inflated above the limits specified in the maintenance procedure. In addition, the outer containment sleeve was at a positive pressure with respect to the operating aisle. An improperly installed bagging ring, coupled with positive pressure in the containment, is believed to have caused the release.

As discussed above, the procedures used are categorized as General Information Use, thus allowing users to regard them as reference material rather than step-by-step instructions. Workers indicated that they would not perform this work without using the procedures, however, the classification makes the procedures less important. Due to the complexity of the seal tube replacement, the hazards involved, and the potential consequences, classification of these procedures as General Information Use is not conservative.

The laboratory radiation safety manual requires non-routine processing of personnel dosimetry upon completion of the task when extremity dosimeters are used. However, workers indicated that some extremity dosimetry may be used for as long as 90 days prior to processing—not in accordance with procedural requirements. Interviews also indicated that the extremity dosimeters used during the seal tube repair have yet to be processed and are still being used on another job in the facility.

3.1.5 Feedback and Improvement

Once the work is complete, feedback mechanisms must exist to continuously improve safety management. Opportunities for improvement should be identified and acted upon to ensure a continuous improvement in the conduct of safe work. Feedback should be accomplished through a combination of worker feedback, management observations, and independent reviews. Information should be gathered, analyzed, and acted upon as necessary to improve the work processes and safety.

In accordance with site procedures, ANL-W conducted a critique of the event on August 20, 1998. The critique was attended by appropriate laboratory, CH, and Office of Oversight personnel. The purpose of the critique was to gather statements from individuals involved in the event and collect necessary facts to evaluate the event.

As a result of this critique and the concern that radiological control practices for maintenance activities needed upgrading, ANL began a full investigation of the event on August 21, 1998. Before completing the investigation, ANL-W began interim improvements in work planning and control in early September. Improvements were also made in the unreviewed question determination process and in the screening process for defining work activities.

The joint investigation conducted by laboratory and DOE personnel identified six judgments of need:

1. The engineering procedure needs to be revised to provide guidance and requirements commensurate with job importance.
2. Manipulator Repair Group training on conduct of operations needs to be improved.
3. Basic skills training needs to be upgraded as appropriate.
4. ANL-W needs to review the methodology used to conduct radiological hazard assessments and upgrade it as appropriate.
5. ANL-W and INEEL need to review communication procedures and develop a way to keep people informed without hindering onsite emergency response.
6. The ANL-W feedback and improvement program needs to be strengthened.

At ANL-W, events that are classified as reportable require submittal of an occurrence report; the final occurrence report includes corrective actions addressing the root cause of the event. At ANL-W, the final occurrence reports are then analyzed, tracked, and reported monthly, semiannually, and annually to senior site managers by the ANL-W Occurrence Reporting Coordinator. The reports to senior management contain graphs and tables showing a breakout of occurrences by facilities and by technical area, and provide the status of open corrective actions. However, only a brief section, entitled "Notes," contains one or two paragraphs that analyze the occurrences in terms of trends that should receive additional management attention.

There were three occurrence reports for radioactive contamination in the FCF over the last two years. The ANL-W Occurrence Reporting Coordinator evaluated these incidents and determined that there was no common trend to be noted in the monthly, semiannual, and annual report for management attention. The ANL investigation reviewed four occurrence reports for contamination incidents from ANL-W since 1993 and one report associated with a manipulator removal at INEEL, concluding that "they are only superficially related and in fact the lessons learned from these occurrence reports could not have been carried over to prevent this event." This conclusion may be correct with respect only to the direct cause for each event. Collectively, however, these occurrence reports could have been used to identify institutional processes or aspects of the management and training environment that required additional attention.

3.2 Emergency Management

The site response to the incident appears to have been appropriate. Personnel were evacuated and surveyed by health physics technicians at the designated rally point. The facility area supervisor followed appropriate procedures and promptly notified the emergency management coordinator of the contamination problems. Conservative actions were taken throughout the response to the event, however, communications problems, inadequate training, and a failure to follow site procedures exacerbated the emergency response efforts.

The ANL-W ECC was activated by the emergency action manager at 1615 based on information received from the on-scene commander and the operations manager. At 1620, the ECC was declared operational. The emergency action manager declared an alert emergency at 1635 based on a concern that some workers could have bypassed the radiation monitors when evacuated from the FCF.

According to site procedures, the alert is declared when the emergency action manager signs the notification form. The ANL-W public information manager is then responsible for conducting the notifications. The checklist requires the form to be faxed and a confirmatory phone call made to the Warning Communications Center (WCC). The public information manager is required by the activation checklist to request the WCC to initiate notifications to all appropriate offsite agencies. This phone call was not conducted in accordance with the procedure, resulting in delayed activation of the INEEL EOC and notification of offsite personnel. State and local authorities were not notified within the 15-minute requirement. Not meeting the requirement could have an adverse impact on the facility if it delays evacuation or notification of needed assistance.

Further review of the emergency management program indicated other concerns that contributed to communications problems associated with the response to this event:

- The ANL-W Emergency Management Plan requires that ANL-W conduct an annual exercise, as well as a full-participation exercise as requested by the INEEL contractor. A full-participation exercise that includes activation of the INEEL EOC and ANL-W ECC has not been conducted during the past two years.

- ANL-W personnel required to report to the INEEL EOC upon declaration of an event did not do so in a timely manner. The ANL-W Emergency Management Plan requires a management representative to report to the INEEL EOC in the event of an emergency. For events involving ANL-W, this representative serves as a technical adviser to the INEEL emergency director. The INEEL emergency director has no authority for ANL-W. Furthermore, the ANL-W roles and responsibilities in the INEEL are not identified in the Emergency Plan Implementing Procedures, nor is the emergency action manager granted the authority to ensure that all appropriate positions are manned. Timely assignment of the ANL-W representative to the INEEL EOC is critical so that important information is provided and appropriate actions are taken with respect to ANL-W emergency response.

- The FCF Emergency Plan allows the response to actual events to be substituted for the annual exercise because events also exercise the emergency procedures. This policy is contrary to the intent of conducting the annual exercise. The annual exercise is intended to be a controlled event that allows each aspect of emergency preparedness to be evaluated and critiqued. Substituting actual events does not permit such evaluation.

- The ECC has established checklists for each position. The individual performing each function is supposed to enter the time when each step on the checklist is performed. Individuals responding to the ECC during this event did not enter these times on their checklists.

While the site addressed the facility emergency and associated communications appropriately in their critique report, the additional concerns associated with the response highlight the need for a strengthened emergency management program at ANL-W. An annual training exercise that tests all aspects of the emergency management program, including activation of the INEEL EOC, would reduce the communications problems and allow emergency responders to efficiently address the issues during a real event. Tabletop scenarios can also be used to supplement the annual exercise to further refine roles and responsibilities in responding to an emergency.

3.3 Post-Event Analysis

The Office of Oversight reviewed the report of the investigation conducted jointly by ANL and CH. Overall, the ANL investigation team was effective in evaluating the incident and the onsite response, determining the direct and root causes, and identifying judgments of need to prevent or minimize future occurrences. The Oversight team concurs with the direct cause for the incident, the eight contributing causes, and the root cause identified in that report. In addition, the Oversight team concurs with the six judgments of need.

However, the report does not address emergency preparedness because it was not included in the original charter. Although the emergency preparedness issues were addressed in a critique on September 3, 1998, some programmatic weaknesses were not addressed, as discussed in Section 3.2. In addition, the ANL and CH team did not identify program deficiencies that were inherent in the radiological control and emergency preparedness practices at the laboratory that are inconsistent with DOE requirements and guidance.

The laboratory developed a plan identifying 24 corrective actions to address the judgments of need, including specific actions to provide additional training, revise the pre-job briefing requirements, reclassify and revise procedures, and perform engineering reviews of modifications. The corrective action plan does not address emergency preparedness issues and only commits to conducting an evaluation of personnel protection requirements. The corrective action plan does not evaluate programmatic issues related to this event, such as engineering design changes, unreviewed safety question determinations, emergency preparedness, and radiological control.

4.0 Conclusions

The Office of Oversight technical review identified three strengths or positive observations associated with this event:

- **Immediate Response.** Facility personnel were conservative in their decision-making in response to the event. Site personnel were promptly evacuated and surveyed by the health physics technicians.

- **Event Investigation.** The investigation team effectively evaluated the event and identified the root causes. This included identifying the direct cause of the event, the contributing causes, and the root cause for the release.

- **Corrective Action Process.** Recognizing the need to comprehensively address this event and two other recent events in FCF, the laboratory is implementing a corrective action process that was effectively implemented in addressing a uranium corrosion product fire at the Fuel Manufacturing Facility.

The Oversight team identified no additional concerns beyond those reported by the ANL investigation, related to the circumstances of the event or the immediate response. However, the Oversight team noted that the corrective action plan does not address several programmatic issues related to this event, such as engineering design changes, unreviewed safety question determinations, emergency preparedness, and radiological control.

5.0 Opportunities for Improvement

The Office of Oversight identified opportunities for improvement in emergency management, radiological controls, and integrated safety management. These opportunities are related to annual full-participation emergency exercises, the ANL-W management representative in the INEEL EOC during events involving ANL-W, roles and responsibilities of emergency management personnel, and the ANL-W ECC checklist.

5.1 Strengthen Emergency Management

Basis: Weaknesses were observed in the emergency management program that led to the communications problems observed in the response to the event. Program weaknesses were observed in the exercise program, procedure usage, emergency plan implementation, and policy governing emergency management at FCF.

Opportunities for Improvement:

- Strengthen the emergency management response by conducting the annual exercise with full participation from INEEL.
- Revise the Emergency Plan Implementing Procedures to ensure that they adequately address the roles and responsibilities and that they are consistent with the emergency plan.
- Revise the INEEL EOC activation procedures to require an ANL-W representative in the EOC for ANL-W events before declaring it operational.

5.2 Improve the Radiological Control Program

Basis: Weaknesses observed in the radiological control program require further program review. Program weaknesses include the use of contamination surveys and dosimetry requirements and work planning consistent with the level of hazard in the work to be accomplished.

Opportunities for Improvement:

- Strengthen the radiological control program by considering the extent of contamination that could be involved in a maintenance activity.
- Increase conservatism in the use of personal protective equipment by considering:
  - Using full anti-contamination clothing
  - Using portable air-monitoring equipment
  - Properly defining radiological boundaries
  - Sealing off potential pathways that could exacerbate a contamination release
  - Requiring the use of extremity dosimetry when repairing seal tubes, and processing the dosimetry promptly.
- Improve the work planning processes to include consideration of potential contaminations and hazards associated with its release.

5.3 Increase Efforts to Establish an Integrated Safety Management Program

Basis: Weaknesses observed in work planning and feedback mechanisms indicate that improvements in the integrated safety management program are necessary to improve facility safety.

Opportunities for Improvement:

- Improve the work planning process to include a complete hazard analysis for work activities associated with the argon cell.
- Improve worker feedback mechanisms to ensure that procedures are usable and can be followed appropriately to conduct work safely.
- Conduct routine management oversight of critical work activities to ensure that they are conducted within controls.
- Strengthen the event review process to evaluate affected programs and develop improved corrective actions to address identified programmatic deficiencies.

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Appendix A

Team Composition

Deputy Assistant Secretary for Oversight

Glenn Podonsky

Associate Deputy Assistant Secretary

S. David Stadler - Operations
Neal Goldenberg - Technical Matters

Director, Office of ES&H Evaluations

Michael Kilpatrick
Patricia Worthington, Deputy Director

Review Team Leader

Victor Crawford, Management Systems

Review Team Members

William Cooper, Radiation Protection
Brad Davy, Maintenance/Work Planning and Control
Richard Lagdon, Emergency Management
Ruby Strong, Administrative Field Support
Kathleen Moore, Technical Editor

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